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Toxics Use Reduction Case Study

MASTEX INDUSTRIES REDUCES CHEMICAL USE IN CLOTH CLEANING AND DYEING OPERATIONS

SUMMARY

Mastex Industries Inc., of Holyoke, Massachusetts, made several changes in its textile manufacturing processes to reduce the use of three toxic chemicals. The company entirely eliminated its use of trisodium phosphate (TSP) for pH adjustment of cloth scouring solutions by replacing it with sodium carbonate, a nontoxic base which is safer to handle than TSP. Mastex also achieved a 25 % reduction in the amount of sodium hydroxide used in cloth cleaning operations by replacement with sodium carbonate. Finally, Mastex reformulated its dye baths to cut sodium nitrite use by 12.5 %. All told, these changes have pared Mastex's use of toxic chemicals by more than 20,000 pounds per year, saving Mastex about $5,000 per year in chemical purchases and regulatory fees, and enhancing worker health and safety.

BACKGROUND

Mastex is an integrated textile manufacturer with approximately 250 employees. The company performs all phases of cloth production, from weaving fibers and making cloth to dyeing cloth and applying a variety of coatings, waterproofers and stiffeners. Mastex can perform any of these operations individually to bolts of cloth or combine them to produce a range of products, from sail cloth to garment linings. Approximately 500,000 yards of cloth are produced on a weekly basis.

The company focused its toxics use reduction efforts on three chemicals used in three separate production processes:

-**Trisodium Phosphate** (TSP) was used to increase the alkalinity of cleaning solutions used to scour cloth. Scouring is necessary to remove dirt and sizing so that cloth fibers can absorb dyes more fully. Scouring solutions are alkaline in order to clean effectively without damage to the cloth.

-**Sodium Hydroxide** is used to raise the alkalinity and enhance the cleaning capacities of cleaning solutions in washing operations. Most cloth produced by Mastex requires washing to remove various soils and chemicals before dyes and final finishes can be applied successfully.

-**Sodium Nitrite** is used in conjunction with acetic acid as a color developer in applying

black dyes to acetate fibers. The sodium nitrite helps to lock the dye permanently into the fiber, reducing the likelihood of fading or bleeding.

TOXICS USE REDUCTION PLANNING

In previous efforts to change chemical formulations, Mastex had learned that laboratory trials are no substitute for actual production runs. Therefore, Mastex began making production runs of cloth using sodium carbonate (a TSP substitute) in scouring and reduced sodium nitrite concentration in dyeing. Mastex ran 54 bolts of cloth, each measuring 3000 yards, through its reformulated scouring processes. Each bolt required between six and nine hours to process. The reformulated dyes were tested on 40 bolts, each of which required approximately seven hours to process. The relatively large number of trials was necessary because Mastex manufactures a large variety of products, and plant officials had to ensure that the altered processes would be compatible with all of them. During the trials, Mastex's toxics use reduction team met six times to review the results and assess effects on product quality.

In the washer operation, Mastex made trial runs on goods for dyeing, which are particularly hard to clean because sizing must be removed from the cloth. Through experimentation, it was discovered that 25 % of the sodium hydroxide could be replaced with sodium carbonate while still meeting cleanliness requirements.

TOXICS USE REDUCTION MODIFICATIONS

Based on the success of the trial runs, Mastex altered the makeup of its chemical baths. Beginning in December 1994, sodium nitrite use was reduced from eight pounds to seven pounds per bolt, while TSP was replaced entirely with sodium carbonate. Beyond the changes to bath makeup specifications, no further changes were necessary; the basic bath makeup procedures were not altered. Mastex also reformulated its wash bath in December, replacing 25 % of the sodium hydroxide with nontoxic sodium carbonate. Product quality has been unaffected by these changes.

In addition to these chemical bath reformulations, Mastex also altered its wastewater treatment system to achieve a drastic reduction in the use of two treatment chemicals: sodium hydroxide and acetic acid. Prior to these changes, alkaline and acidic waste streams from dyeing jigs and the washer were neutralized in separate one-step processes. Acetic acid was used to neutralize alkaline waste streams and sodium hydroxide was used for acidic streams. This neutralization technique was imprecise and prone to creating pH spikes in wastewater. Now, alkaline and acidic waste streams are combined in order to partially or fully neutralize each other. Once mixed, the pH of the waste stream is again measured and, if necessary, the appropriate neutralizing chemical is added to meet discharge limits. Mastex estimates that this new treatment procedure could reduce wastewater treatment chemical use by about 90 %, saving nearly 17,000 pounds of sodium hydroxide and 4,000 pounds of acetic acid annually.

Mastex is assessing the viability of several other toxics use reduction projects. The reduction in sodium nitrite was made based upon the simplest means of changing the bath, reducing additions from eight to seven pounds. Mastex will be experimenting with further sodium nitrite reductions to determine whether additional reductions can be made without adverse effects on product quality. The company is also experimenting with potential substitutes for the acetic acid which it uses in

conjunction with sodium nitrite for developing black dyes in acetate fibers. In previous trials, the company has found that acetic acid cannot be replaced entirely without affecting product quality. Mastex is now experimenting with 40/60 and 60/40 mixtures of acetic acid and a substitute, in order to determine whether less acid can be used.

RESULTS

Reductions Achieved: Based on 1993 chemical usage, Mastex believes the elimination of TSP will save 16,000 pounds in chemical use. In the washer operation, replacement of sodium hydroxide with sodium carbonate will reduce sodium hydroxide use by 2,750 pounds (25 %). The reformulation of dye baths will save 12.5 % , or 1,625 pounds per year, in sodium nitrite use.

As noted above, Mastex expects that the redesign of its wastewater treatment procedure will lead to further savings of about 17,000 pounds of sodium hydroxide and 4,000 pounds of acetic acid.

Economics: Due to the lack of data, Mastex is unable to quantify any savings attributable to these TUR changes over any length of time. However, since the trials were conducted on production runs, the savings can be estimated on an annual basis. The reduction of sodium nitrite will save Mastex approximately $780 in purchase costs. Eliminating TSP from the scouring operation will save $1100 in Form S TURA fees, and will reduce the burden on employee time associated with TURA reporting and planning requirements. Finally, the replacement of sodium hydroxide with the less expensive sodium carbonate will reduce annual chemical purchase costs by an additional $3520.

One of the most important benefits of these changes does not show up on the bottom line. This is the reduction of worker exposure to toxic and hazardous chemicals. In particular, sodium carbonate is less dangerous than TSP for workers to handle.

This case study is one in a series prepared by the Office of Technical Assistance (OTA), a branch of the Massachusetts Executive Office of Environmental Affairs. OTA's mission is to assist industry in reducing the use of toxic chemicals and/or the generation of toxic manufacturing byproducts. Mention of any particular equipment or proprietary technology does not represent an endorsement of these products by the Commonwealth of Massachusetts. This information is available in alternate formats upon request. OTA's ***confidential, nonregulatory*** *services are available at* ***no charge*** *to Massachusetts businesses and institutions that use toxics. For further information about this or other case studies, or about OTA's technical services, contact:* ***Office of Technical Assistance, 100 Cambridge Street, Room 2109, Boston, Massachusetts 02202; phone # (617)727-3260; fax # (617)727-3827; electronic bulletin board # (617)727-5621.***